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(54) Abstract Title
Conveyor transfer system

(57) A conveyor system eg for the conveyance of vehicle bodies through a paint shop, includes an inverted power and free (IPF) conveyor including a fixed track 11 which supports and guides a trolley assembly 10 including a workpiece carrier 15 while being driven by movable chain 21. A twin (or single) strand conveyor 25 with belts 32, 33 arranged side by side straddles the IPF conveyor and the workpiece carrier 15 is transferred from the IPF conveyor to the twin strand conveyor 25 by lifting rollers 36, 37 arranged on each side of the track 11 and operated by lifting actuator assemblies 38, 39. The workpiece carrier 15 maybe supported on telescopic pillars 17 so that the trolley assembly travels with the workpiece carrier 15 whilst this is on the twin strand conveyor. At the other end of the twin strand conveyor 25 there maybe a mirror image of the arrangement shown where the workpiece carrier is lifted off the twin strand conveyor and again supported by the trolley assembly.

The system may include an accumulating trolley 12 and leading and trailing trolleys 13, 14. The accumulating trolley 12 has a retractable dog 19 which engages a conveyor chain 21 movable linearly relative to the track 11.

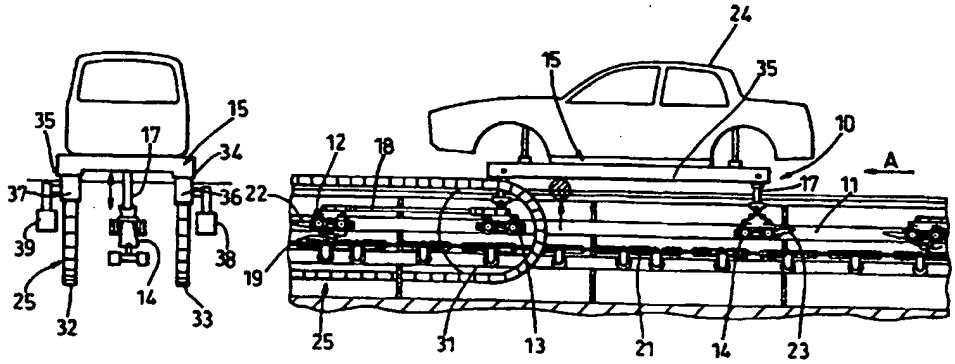

Fig. 1

Fig. 2

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

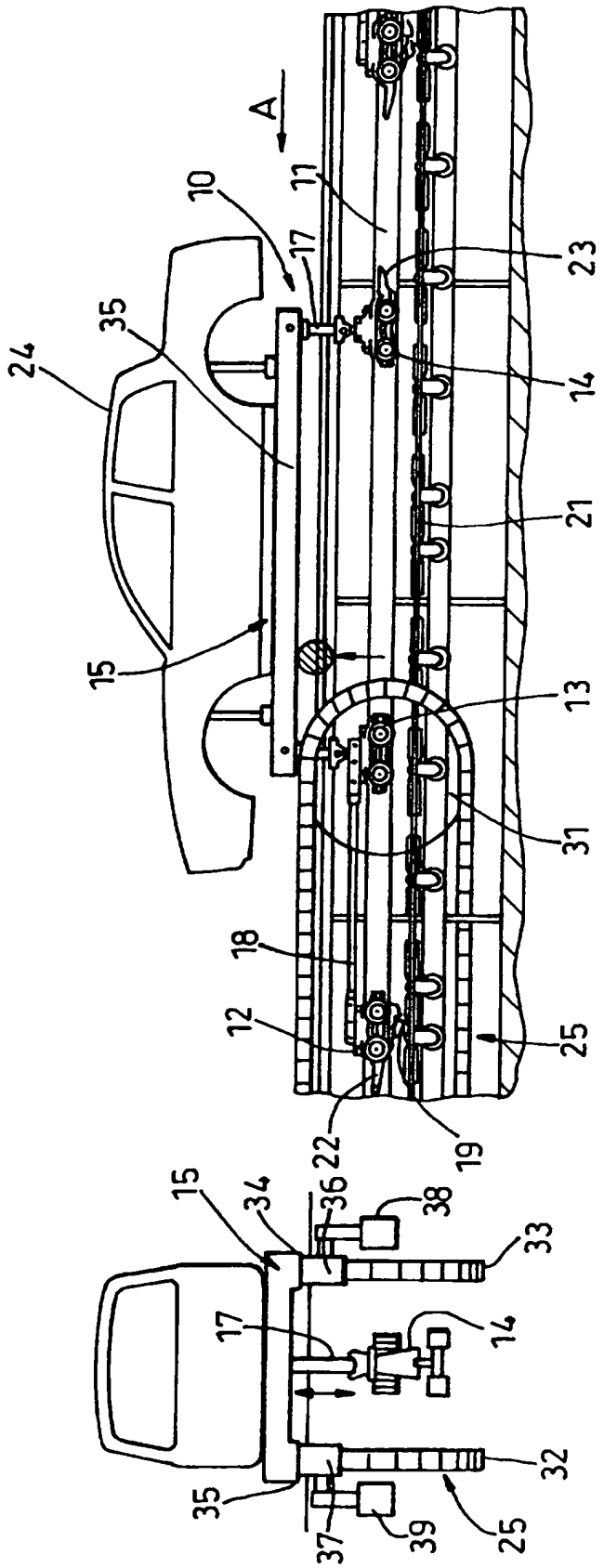
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Fig. 1

Fig. 2

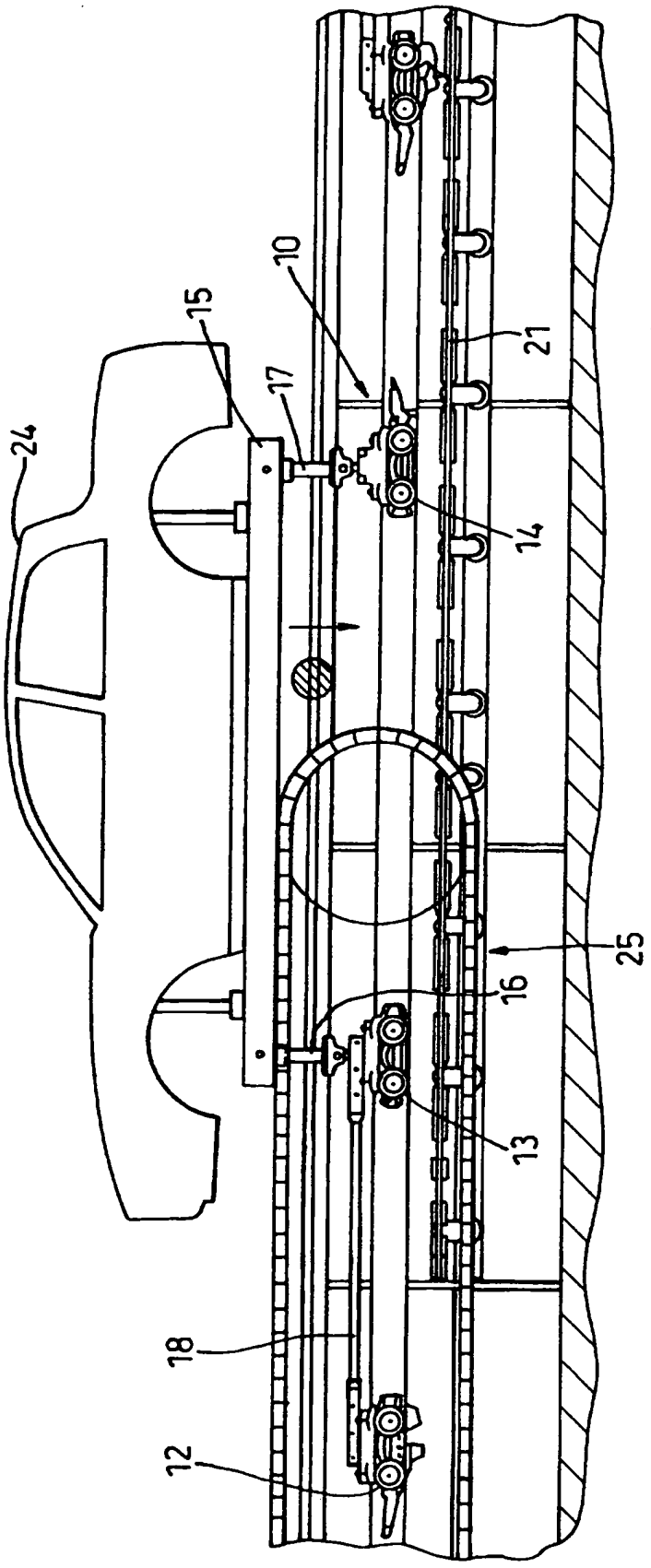

Fig. 3

Conveyor System

The present invention relates to conveyor systems and particularly but not exclusively to conveyor systems for use in connection with the conveyance of vehicle bodies through a paint shop of a vehicle manufacturing plant.

Typically within many automated manufacturing processes a conveyor is used in order to move a workpiece between work stations. A preferred type of conveyor is a chain type which comprises a fixed track, a conveyor chain movable linearly relative to the track, a carrier trolley assembly which is engageable with the chain for driven movement along the track and a workpiece carrier supported by the trolley assembly. One example of such a conveyor is the inverted power and free (IPF) type.

Unfortunately, chain type conveyors have an inherent backlash problem which present difficulties for some continuous automated processes where positional accuracy of the workpiece is required. Such backlash problems can occur in the paint spraying of vehicle bodies, particularly interiors. If the workpiece is not accurately positioned it is difficult to position a robotic paint spraying head relative to the workpiece without some form of feedback system which adds to cost. Repeatability of painting operations requires consistency and accuracy of workpiece position. This can be provided by known belt type conveyors such as a twin strand conveyor.

Nevertheless, chain type conveyors such as the IPF have many virtues for use elsewhere in the vehicle body manufacture and assembly operation so it is an objective of the present invention to provide a conveyor system which can utilise the benefits of a chain type conveyor and a belt type conveyor.

According to one aspect of the invention there is provided a conveyor system comprising a fixed track, a conveyor chain movable linearly relative to the track, a carrier trolley assembly which is engageable with the chain for driven movement along the track, a workpiece carrier supported by the trolley assembly, a belt conveyor arranged in line with the fixed track and comprising at least one movable belt which is engageable with the workpiece carrier to support and move the carrier linearly relative to the track in the same direction as the trolley assembly and transfer means arranged to transfer support of the workpiece carrier from the trolley assembly onto the belt conveyor.

Preferably, the transfer means is arranged to lift the workpiece carrier relative to the trolley assembly and lower the workpiece carrier onto the belt conveyor. Conveniently, the transfer means is arranged to lift only the leading end of the workpiece assembly

The transfer means may include at least one roller arranged to engage an undersurface of the workpiece carrier, in which case the or each roller may be actuated by a respective actuator to lift and lower the workpiece carrier. Alternatively, the undersurface of the workpiece carrier may be profiled to lift and lower the workpiece carrier as the workpiece carrier traverses over the or each roller.

The undersurface of the workpiece carrier may be profiled to contact the or each belt where the or the respective belt curves over an end rollers to engage and lift the workpiece carrier onto the or each belt.

Conveniently, the trolley assembly is arranged to continue to move with the workpiece carrier when the workpiece carrier is supported on the belt conveyor.

The trolley assembly may be arranged to disengage from the chain when the workpiece carrier is supported on the belt conveyor.

The belt conveyor may be a twin strand belt conveyor arranged with a belt on each side of the track .

Further transfer means may be arranged to transfer support of the workpiece carrier from the belt conveyor back onto the trolley assembly.

In another aspect, the invention also provides method of conveying a workpiece carrier including providing a conveyor comprising a fixed track, a conveyor, chain movable linearly relative to the track and a carrier trolley assembly which is engageable with the chain for driven movement along the track and supports the workpiece carrier, providing a belt conveyor arranged in line with the fixed track and comprising at least one movable belt which is engageable with the workpiece carrier to support and move the carrier linearly relative to the track in the same direction as the trolley assembly and providing transfer means which is arranged to transfer support of the workpiece carrier from the trolley assembly onto the belt conveyor.

The invention will now be described by way of example with reference to the accompanying drawings, in which:

Fig.1 is a schematic side elevation of a conveyor transfer system according to the invention;

Fig.2 is a schematic rear elevation shown in Fig.1 as viewed on arrow A; and

Fig.3 is a view similar to Fig.1 but with the workpiece carrier at a slightly later stage.

A conveyor transfer system includes a fixed track 11 which acts to support and guide a trolley assembly 10 comprising three individual trolley units, an accumulating trolley 12, a leading trolley 13 and a trailing trolley 14. The leading trolley 13 and the trailing trolley 14 support a workpiece carrier 15 by means of pillars 16, 17 which allow the leading and trailing trolleys 13, 14 to pivot relative to the workpiece carrier 15, the workpiece carrier 15 linking the leading and trailing trolleys 13, 14 and so forming part of the trolley assembly 10. The accumulating trolley 12 is linked to the leading trolley 13 by a draw bar 18 which is pivoted to both the accumulating trolley 12 and the leading trolley 13. It should be noted that whilst the pillars 17 normally support the workpiece carrier 15, they can also extend, i.e. are telescopic, and use is made of this property, as will be explained later.

The accumulating trolley 12 has a retractable dog 19 which engages with a conveyor chain 21 which is movable linearly relative to the track 11, the retractable dog 19 being actuated by means of an actuating arm 22 which extends from the front of the accumulating trolley 12 and which can engage an accumulation cam 23 at the rear of the trailing trolley 14 of the preceding trolley assembly 10. Note that the accumulating trolley 12 of the following trolley assembly 10 is also shown in Fig.1. If the preceding trolley assembly stops for whatever reason or if a cam corresponding to the accumulation cam 23 is placed in the path of the actuator arm 22, then the actuator arm is operated to lift the retractable dog 19 from the chain so that successive trolley assemblies can accumulate or bunch together.

The arrangement of track 11, trolley assembly 10, workpiece carrier 15 and conveyor chain 21 as described so far is generally conventional and is known as an inverted power and free (IPF) conveyor system. As such it is a convenient system for the transfer of workpieces such as vehicle bodies during assembly operations

and for transporting body-in-white body shells before and after processing and painting. However, the arrangement of the retractable dog 19 in engagement with the conveyor chain 21 has inherent backlash problems both in the chain itself and where the dog engages it and this makes the system less suitable for delicate robotic operations such as interior painting of a body shell 24. For this a belt conveyor is more suitable since the belt can move at a controlled speed and a workpiece carrier or workpiece carried on it will travel at the same speed. One convenient form of belt conveyor is the twin strand conveyor where two belts are arranged side by side. In the present example of invention such a twin strand conveyor 25 is arranged to straddle, i.e. lie either side of, the IPF conveyor and the workpiece carrier 15 is transferred from the IPF conveyor to the twin strand conveyor 25.

The twin strand conveyor 25 includes a pair of end rollers 31 and twin belts 32 and 33 which are arranged for supporting the workpiece carrier 15 by means of side skids 34 and 35. Lifting rollers 36 and 37 are arranged on each side of the track 11 immediately in front of the end rollers 31 and are supported by lifting actuator assemblies 38, 39.

In use, as the workpiece carrier 15 approaches the twin strand conveyor 25 a sensor or proximity switch (not shown) causes the lifting actuators 38, 39 to move the lifting rollers 36, 37 into contact with the side skids 34, 35 and lift the front or leading end of the workpiece carrier 15 just above the belts 32 and 33. When the workpiece carrier 15 is a reasonable distance over the twin strand conveyor 25 further actuation of the proximity switch or sensors (or actuation of further switches or sensors) causes the lifting actuators 38, 39 to lower the lifting rollers 36, 37 and allow the side skids 34, 35 to rest on the belts 32, 33. The belts 32, 33 are arranged to travel forward at the same speed as the conveyor chain 21 so that

there is no relative movement between the workpiece carrier 15 and the upper run of the belts 32, 33.

Fig.3 shows the workpiece carrier 15 just after it is lowered onto the twin strand conveyor 25. At this stage the retractable dog 19 on the accumulating trolley 12 is made to disengage from the chain 21 and this is diverted away from the twin strand conveyor by an appropriate sprocket or pulley.

At the other end of the twin strand conveyor 25 there is effectively a mirror image of the arrangement shown in Figs.1 and 3 where the workpiece carrier is lifted off the twin strand conveyor and again supported by the trolley assembly 10. It should be noted that since the pillars 17 are telescopic the trolley assembly 10 travels with the workpiece carrier 15 whilst this is on the twin strand conveyor.

Instead of the lifting rollers 36, 37 being actuated by actuators 38, 39 they may be fixed and the undersurface of the side skids 34, 35 profiled to act as cams to raise and lower the workpiece carrier as previously described. Alternatively, the side skids 34, 35 may be profiled at the front and rear to allow the belts 32, 33, where they curve over the end rollers 31, to engage and lift the workpiece carrier 15 onto the twin strand conveyor 25.

It will be understood that the term belt as applied to the belts 32, 33 of the twin strand conveyor 25 includes flexible belting, e.g. fibre reinforced elastomer, and chain type belting, i.e. chain links which extend over an appreciable width to provide a supporting surface. instead of there being twin belts there may be a single belt or three or more as determined by the size and shape of the workpiece and the workpiece carrier.

CLAIMS

1. A conveyor system comprising a fixed track, a conveyor chain movable linearly relative to the track, a carrier trolley assembly which is engageable with the chain for driven movement along the track, a workpiece carrier supported by the trolley assembly, a belt conveyor arranged in line with the fixed track and comprising at least one movable belt which is engageable with the workpiece carrier to support and move the carrier linearly relative to the track in the same direction as the trolley assembly and transfer means arranged to transfer support of the workpiece carrier from the trolley assembly onto the belt conveyor.

2. A system according to claim 1 wherein the transfer means is arranged to lift the workpiece carrier relative to the trolley assembly and lower the workpiece carrier onto the belt conveyor.

3. A system according to claim 2 wherein the transfer means is arranged to lift only the leading end of the workpiece assembly

4. A system according to any preceding claim wherein the transfer means includes at least one roller arranged to engage an undersurface of the workpiece carrier.

5. A system according to claim 4 wherein the or each roller is actuated by a respective actuator to lift and lower the workpiece carrier.

6. A system according to claim 4 wherein the undersurface of the workpiece carrier is profiled to lift and lower the workpiece carrier as the workpiece carrier traverses over the or each roller.

7. A system according to claim 3 wherein the undersurface of the workpiece carrier is profiled to contact the or each belt where the or the respective belt curves over an end rollers to engage and lift the workpiece carrier onto the or each belt.

8. A system according to any preceding claim wherein the trolley assembly is arranged to continue to move with the workpiece carrier when the workpiece carrier is supported on the belt conveyor.

9. A system according to any preceding claim wherein the trolley assembly is arranged to disengage from the chain when the workpiece carrier is supported on the belt conveyor.

10. A system according to any preceding claim wherein the belt conveyor is a twin strand belt conveyor arranged with a belt on each side of the track .

11. A system according to any preceding claim wherein further transfer means is arranged to transfer support of the workpiece carrier from the belt conveyor back onto the trolley assembly.

12. A method of conveying a workpiece carrier including providing a conveyor comprising a fixed track, a conveyor chain movable linearly relative to the track and a carrier trolley assembly which is engageable with the chain for driven movement along the track and supports the workpiece carrier, providing a belt conveyor arranged in line with the fixed track and comprising at least one movable belt which is engageable with the workpiece carrier to support and move the carrier linearly relative to the track in the same direction as the trolley assembly and providing transfer means which is

arranged to transfer support of the workpiece carrier from the trolley assembly onto the belt conveyor.

13. A method according to claim 12 including the steps of lifting the workpiece carrier relative to the trolley assembly by the transfer means and lowering the workpiece carrier onto the belt conveyor.

14. A method according to claim 14 wherein the transfer means lifts only the leading end of the workpiece assembly

15. A method according to any of claims 12 to 14 wherein the transfer means includes at least one roller which engages an undersurface of the workpiece carrier.

16. A method according to claim 15 wherein the or each roller is actuated by a respective actuator to lift and lower the workpiece carrier.

17. A method according to claim 15 wherein the undersurface of the workpiece carrier is profiled to lift and lower the workpiece carrier as the workpiece carrier traverses over the or each roller.

18. A method according to claim 14 wherein the undersurface of the workpiece carrier is profiled to contact the or each belt where the or the respective belt curves over an end rollers to engage and lift the workpiece carrier onto the or each belt.

19. A method according to any of claims 12 to 18 wherein the trolley assembly continues to move with the workpiece carrier when the workpiece carrier is supported on the belt conveyor.

20. A method according to any of claims 12 to 19 wherein the trolley assembly disengages from the chain when the workpiece carrier is supported on the belt conveyor.

21. A method according to any of claims 12 to 20 wherein the belt conveyor is a twin strand belt conveyor arranged with a belt on each side of the track .

22. A method according to any of claims 12 to 21 wherein further transfer means transfers support of the workpiece carrier from the belt conveyor back onto the trolley assembly.

23. A conveyor system substantially as described herein with reference to the accompanying drawings.

24. A method of conveying a workpiece carrier substantially as described herein with reference to the accompanying drawings.

The Patent Office

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Application No:	GB 9915401.5	**Examiner:**	Paul Makin
Claims searched:	1-24	**Date of search:**	27 September 1999

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.Q): B8A (AGC) ; B7B (BR)

Int Cl (Ed.6): B62D 65/00 ; B65G 17/12, 47/52

Other: Online : WPI, EPODOC, PAJIO

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
Y	GB 2085389 A	(INVENTIO AG) see Figures 1-4 and trolley 2.	1,2,3,7, 8,10-14, 18,19, 21,22
Y	US 5577593	(HOOPER) see Figures 1-3.	1,2,3,7, 8,10-14, 18,18 21,22
X	US 4665832	(MASAFUMI et al) see Figures 1 & 2.	1,2,3,10, 12,13, 14,21.

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.